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Quality of Life (QoL) in Glaucoma Patients

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1. Introduction

The interest of clinicians and researchers concerning the quality of life (QoL) assessment in chronic diseases increases constantly. Many definitions have been proposed for the term quality of life, but it is commonly accepted that a universal definition of QoL is rather infeasible to be given. Furthermore, Aaronson has noted the multidimensionality of QoL in terms of physical (symptoms of a disease and treatment), functional (activities of daily living, mobility), social (interpersonal contacts and relationships) and psychological (mental health, emotional balance) parameters that compose it.¹

Since the first research efforts that tried to examine QoL in glaucoma², serious advancement has been accomplished in this field, offering a better understanding of how and to what extend glaucoma influences QoL of individuals suffering from the disease. In addition, glaucoma QoL research yielded important insights with regard to the domains of daily living that are mostly affected by the disease.

It is well documented that glaucoma is a leading cause of visual impairment and blindness. Epidemiologic studies demonstrate that 2% of adults over the age of 40 suffer from glaucoma, with the disease prevalence increasing significantly with age.^{3,4} Vision loss exerts a negative impact on physical ability of patients to perform activities of daily living (reading, adapting to different levels of light, outdoor mobility, avoiding obstacles, etc.), despite maintenance of central visual acuity in less advanced stages of the disease.⁵ Furthermore, literature suggests that patients with impaired QoL form a more severe burden on health-care resources.^{6,7}

Knowledge and information regarding the QoL of glaucoma patients could be useful in several aspects. It can help 'decision making' concerning customized disease management of individuals with glaucoma and promote alterations and guidelines regarding patients' daily living and safety (i.e. adjustment of home environment), in order to avoid problems concerning adaptation to variable lighting conditions, avoiding obstacles, near activities, outdoor mobility/activities (walking, driving) and other tasks that glaucoma patients seem to give the greatest importance and are significantly correlated with their QoL.^{8,29} The diagnosis of glaucoma impacts individuals differently, with the majority of cases having little understanding of the need for adherence to their daily therapeutic regimen and the disease natural course and progress.⁹ Towards this direction, information gained from QoL studies could improve the education of newly diagnosed patients and help them realize the severity of the disease and the importance of the adherence to daily treatment, despite the fact that symptoms are absent in early stages.

Deterioration of quality of life due to glaucoma can occur because of many reasons. The diagnosis itself, the progressive visual field loss, the intolerance of daily treatment, the side effects of topical anti-glaucoma medication (i.e. allergic conjunctivitis, dry eye, blepharitis), the constrictions concerning daily activities and the need of intensive and long-lasting observation and monitoring on an outpatient basis are some of these causes. In addition QoL is a more subjective rather than objective assessment,¹⁰ since individuals with common visual deterioration due to glaucoma may estimate their QoL state differently. It is then obvious why QoL is considered to be subjective and multidimensional,¹ and why its assessment and the extent of the impact that glaucoma exerts on it is difficult to be accomplished and evaluated.

In general, QoL can be estimated by means of a series of instruments-questionnaires. In specific, generic health-related [the Short Form Health Survey-36 (SF-36), the Sickness impact Profile (SIP)], vision-specific (VS) [the Visual Function-14 (VF-14), the National Eye Institute Visual Function Questionnaire-25 (NEIVFQ-25)] and glaucoma-specific [the Glaucoma Symptom Scale (GSS), the Glaucoma Quality of Life-15 (GQL-15)] QoL instruments (Table 1) have been employed to better rate glaucoma's impact on patients' daily living and enlighten clinicians about how patients experience the effect of glaucoma in their quality of life.

2. Validation of QoL instruments

Proper validation of a questionnaire's basic psychometric properties is considered a prerequisite (before it is administrated to subjects and implemented to studies), in order its' efficacy to be established. Psychometric properties indicate the quality status of an instrument and can be assessed by the classic test theory and/or by Rasch analysis. Both methods provide significant information about item selection, subscale structure and interpretability of an instrument.

The basic psychometric properties that are based on classic test theory are the 'content validity' and the 'internal consistency', the 'construct validity', the 'reproducibility' and the 'respondent burden' of an instrument.

'Content validity' evaluates if the items of the questionnaire measure the basic parameter (i.e. QoL) that is purported to measure and is necessary during the development of the tool.¹¹ It consists from 3 phases: item collection phase, item reduction phase and segregation of items in subscales phase that is accomplished by factor analysis or principal component analysis. 'Internal consistency' assesses the affinity of both the questionnaires' items and subscales. It is measured by calculation of the Cronbach α value. Cronbach α should range between 0.70-0.90.¹²

'Construct validity' expresses the associations of an instrument with other measurements or questionnaires (i.e. visual field (VF) scores, visual acuity). No specific measurement or value evaluates construct validity.

'Reproducibility' evaluates the extent to which the instrument's scores have limited fluctuations after repetition (test-retest reproducibility) or between observers (inter-observer reproducibility). The intraclass correlation coefficient (ICC) and the Bland-Altman analysis are the most common measures of reproducibility.¹²⁻¹⁴

'Respondent burden' demonstrates the questionnaire's demands from the respondents (i.e. time needed to respond to the instrument, emotional burden placed on respondents, the ratio of missing items). Andresen suggested that 15 min is the maximum temporal limit of a questionnaire's completion regarding disabled people.¹⁵

QoL Instruments	Features
<i>Generic Health-related</i>	
SF-36	36 items, 8 subscales: general health, mental health, physical functions, social functions, role limitations by physical/ mental disability, vitality and pain
MOS-20	Shorter version of SF-36. 20 items, 6 subscales: physical functioning, social functioning, role functioning, mental health, health perceptions, pain
SIP	136 items, 12 subscales, implemented by CIGTS after modification
<i>Vision-Specific</i>	
VF-14	14 items/ vision-related activities, originally designed to evaluate functional impairment in cataract patients
ADVS	20 items, 5 subscales: distance vision, near vision, day driving, night driving and glare, originally designed to evaluate functional impairment in cataract patients
NEI-VFQ	51 items, 12 subscales; NEI-VFQ 25: 25 items, 12 domains, shorter and more practical tool from NEI-VFQ
IVI	32 items, 5 subscales: leisure and work, consumer and social interaction, household and personal care, mobility and emotional reaction to vision loss
VAQ	30 items, 8 subscales: acuity/ spatial vision, peripheral vision, visual search, visual processing speed, color discrimination, glare disability, light/ dark adaptation and depth perception.
<i>Glaucoma-Specific</i>	
GSS	10 items, 2 subscales: (non-visual) symptom and visual ability
GQL-15	15 (glaucoma-specific) items demonstrating significant association with visual field loss
SIG	43 items, 4 subscales: visual ability, local eye, systemic and psychological, developed for the CIGTS
GHPI	6 items addressing the ‘physical’, ‘emotional’, ‘social’ and the ‘stress’ and ‘worry of blindness associated with glaucoma’ effects on QoL, developed for the CIGTS

Table 1. Prevalent QoL questionnaires used in glaucoma-related studies

On the other hand, Rasch analysis provides interval ratings regarding the items’ difficulty (item measures), the response choices (of an item) (response measures) and the persons’ ability (person measures),¹⁶ usually by means of fit (infit/outfit) meansquare (MNSQ) statistics.¹⁷ Fit statistics calculate errors in the item, response and person measures that can occur because of redundancy or inappropriate construction during item and response choices selection. MNSQ values between 0.7 and 1.3 are considered acceptable. Items or

response choices with MNSQ values outside these limits are considered misfitting and should be rephrased or omitted during the instrument's development.¹⁸ When items 'fit' the model, then the instrument measures the underlying trait (i.e QoL).

In addition, another basic component of Rasch analysis is the 'person separation' measure. 'Person separation' measures the ability of an instrument to distinguish subgroups of individuals (or items).¹⁹ The higher the (person separation) reliability coefficient, the more subgroups can be discriminated. In order a questionnaire to be considered acceptable the reliability coefficient should be at least 0.8 (it is able to discriminate 3 groups).¹⁹

3. Generic health-related instruments

Health-related tools try by nature to estimate the overall quality of life of subjects, without taking into account separate coexisting diseases or assessing how they individually impact QoL. It is rather difficult to attribute possible decreased QoL scores recorded by general health-related instruments only to glaucoma, without taking into account other co-morbidities that may also affect results. Thus, it is not surprising that general health-related tools lack sensitivity in the glaucoma QoL assessment domain.

3.1 The medical outcomes study (MOS-20) and the short form-36 (SF-36)

The SF-36 questionnaire contains 36 questions that are divided into eight subscales.²⁰ It has been used widely and administrated to patients with different diseases, it is suitable for self-administration and is considered reliable.²¹ The MOS-20 composes a shorter form of the SF-36.²²

The administration to glaucoma patients showed ambiguous results. A study found that glaucoma patients provided the lowest scores among three groups (glaucoma patients, glaucoma suspects and healthy subjects),²³ while another study indicated similar SF-36 scores between glaucoma and normal individuals. Furthermore, glaucoma seemed to greater affect vitality, mental health, bodily pain and social functioning domains.^{2,24} Nevertheless, correlations between SF-36 subscales and visual acuity or visual field impairment have been found relative weak, and therefore it is considered unsuitable for the QoL assessment in glaucoma.²⁵ Glaucoma subjects presented significantly lower scores than healthy individuals in all MOS-20 subscales except pain.²⁶ General health, physical and role functioning MOS-20 domains demonstrated the most significant differences between the two groups (-22%, -20% and -43%, respectively).²⁶

3.2 The sickness impact profile (SIP)

The SIP questionnaire was initially developed in order to provide a measurable instrument of general health status that would be able to record the impact of different disease states. It includes 136 items categorized in 12 domains and showed good test-retest reliability and internal consistency. It takes more than 30 minutes to complete, is not user friendly and is unsuitable for implementation in daily clinical practice.²⁷

The SIP instrument was employed by the Collaborative Initial Glaucoma Treatment Study (CIGTS) and after modification it was administrated to newly diagnosed glaucoma patients. Although showing good psychometric properties, the correlations between QoL measurements and clinical parameters were found weak but significant. In addition, glaucoma exerted a slightly stronger impact on the patients' psychological domain than the physical one.²⁸⁻³⁰

4. Vision specific instruments

Vision specific tools belong to the category of QoL instruments that try to directly link the quality of life status of individuals with a certain human function. These questionnaires have been commonly administered to ophthalmic patients, trying to assess the QoL status in a wide range of ocular diseases, including glaucoma.

4.1 The visual function-14 (VF-14)

The VF-14 was constructed to assess vision-specific functional activities in cataract patients. It consists of 14 vision-related activity questions.³¹ Studies suggest that VF-14 has good internal consistency and that VF-14 scores correlate with visual acuity stronger than health-related instruments.³²

After administration to glaucoma patients, the VF-14 showed moderate correlation with visual field loss and visual acuity.^{2,40} However VF-14 proved incapable to distinguish normal from glaucoma subjects ($P=0.07$).⁴⁰ In another publication, glaucoma patients presented worse weighted mean VF-14 scores than cataract subjects but better than AMD patients.³³ Furthermore, it doesn't assess colour vision and other significant factors indicating optic nerve damage, making it inappropriate for QoL rating in glaucoma and in optic neuropathies in general.

4.2 The activities of daily vision scale (ADVS)

The ADVS includes 20 items categorized in the following subscales: near vision, far vision, day and night vision/driving, glare and overall vision. It is a cataract-oriented tool with good psychometric properties and is easy to use.³⁴

ADVS was able to discriminate glaucoma patients from healthy subjects and ADVS scores showed significant correlation with visual acuity and visual field scores in patients with glaucoma.²⁶ Furthermore, individuals with bilateral glaucoma reported more difficulty (3 times greater probability) on the ADVS than normal subjects, while more advanced binocular VF impairment was correlated with a greater probability of selecting the most difficulty (response scale) on the instrument.³⁵ Patients with unilateral glaucoma in the study demonstrated an average mean defect VF index (MD) in the worse eye of -6.5 dB, while the average MD for the bilateral glaucoma group was -12.0 dB. The study could not elucidate whether the greater perceived difficulty found was due to bilaterality or greater VF loss.³⁵ However the questionnaire doesn't evaluate the parameter of peripheral field and therefore is less relative to glaucoma patients.

4.3 The national eye institute visual function questionnaire -51 (NEI-VFQ) and -25 (NEI-VFQ 25)

The NEI-VFQ and NEI-VFQ 25 instruments are used as benchmarks in the vision-related QoL evaluation and many disease-specific tools are compared with them in order their efficacy to be established. The NEI-VFQ is a fully validated, 51 item, 12-domain tool that has been widely used in several ocular morbidities. The NEI-VFQ 25 is a 25 item, 12 domain instrument that is a shorter and more practical version of its predecessor, designed mainly for clinical settings, with its validity proven to be similar with that of the NEI-VFQ.^{36,37}

Studies agree that the domains affected greater in glaucoma subjects are mainly general health, general vision, mental health, expectations, driving and near activities both for NEI-VFQ and NEI-VFQ 25 questionnaires.^{2,24,33,38-39} Both tools are shown to be capable of

distinguishing glaucoma from normal control subjects, with the scores of glaucoma patients being significantly poorer on most subscales. In addition, lower scores correlated well with visual field loss of glaucoma patients in the eye with the least visual field deterioration.⁴⁰

4.4 The impact of vision impairment (IVI)

The IVI questionnaire is a vision-specific QoL instrument that consists of 32 queries divided in 5 subscales: leisure and work, consumer and social interaction, household and personal care, mobility, and emotional reaction to vision loss.⁴¹

After administration to patients with glaucoma or age related macular degeneration (AMD), responses from glaucoma patients were greater (indicating more difficulty to a certain domain) in most subscales, including emotional reaction to vision loss, leisure, mobility, household and social interaction domains.⁴¹ Only the social interaction subscale score was found greater for AMD subjects (indicating more difficulty in this domain).⁴¹ When it was administered only to glaucoma subjects, responses to the subscale 'mobility' were the most limited and were proved to correlate significantly with binocular (Esterman) visual field deterioration.⁴²

4.5 The visual activities questionnaire (VAQ)

The VAQ instrument consists of 33 items that assess the difficulty of individuals in performing common visual activities. A 1-5 rating score for each item is used regarding the frequency of each visual-related problem. A score of 1 indicates 'never', whereas 5 indicates 'always'. It provides a total score and VAQ items are further organized in 8 subscales: acuity/spatial vision, peripheral vision, visual search, visual processing speed, color discrimination, glare disability, light/dark adaptation and depth perception.⁴³

Concerning glaucoma, the instrument was also employed by the CIGTS demonstrating good psychometric features.²⁸ The total VAQ and subscale scores, correlated weakly but significantly with visual acuity and VF scores of the better eye.^{28,30} Particularly the peripheral vision subscale showed the strongest correlations with clinical measures (i.e. VA, MD, CIGTS scores).^{28,30} The instrument was found to associate less strongly with glaucoma-related clinical measures than the NEI-VFQ.⁴⁴

5. Glaucoma specific instruments

Glaucoma specific tools belong to the disease specific QoL instruments category. It has been demonstrated that they perform a better discriminating ability between glaucoma and normal subjects (specificity for glaucoma). Most of these instruments evaluate both symptoms that are relevant to glaucoma and instillation of anti-glaucoma medications (i.e. blurry/dim vision, difficulty in seeing in daylight, halos around lights, itching, dryness, tearing) and difficulty in performing daily activities.

5.1 The glaucoma symptom scale (GSS)

It includes 10 items, grouped into 2 domains: the non-visual symptoms (six items) and the visual ability (four items) subscales.⁴⁵ The instrument was found to demonstrate a good internal consistency (Cronbach $\alpha > 0.70$ for both domains), while GSS visual ability subscale showed good correlations with many NEI-VFQ subscales.⁴⁵ Furthermore, it is short and easy to use and thus, very practical for implementing in daily clinical practice.

Both GSS subscale responses were rated lower for glaucoma patients, when compared with normal control individuals. The GSS visual ability domain served as a better discriminator between glaucoma and non-glaucoma subjects.⁴⁵ However, GSS scores did not demonstrate significant correlation with Esterman (binocular) visual field alterations and visual acuity was found to associate only moderately with few GSS scores.^{42,45} Furthermore, the instrument excludes treatment related effects on QoL assessment.

5.2 The glaucoma quality of life-15 (GQL-15)

GQL-15 was constructed after administration of 50 questions to 47 glaucoma patients who were divided into three groups according to the degree of their visual field loss (mild ($n = 18$), moderate ($n = 19$), and severe visual field loss ($n = 10$)) and 19 normal controls.⁴⁶

Fifteen questions demonstrated significant association with vision field loss and finally were included in the GQL questionnaire.⁴⁶ Six questions were relevant to glare, six questions were relevant to peripheral vision, two questions were relevant to the central-near vision, and finally one question was associated with the outdoor mobility. All three glaucoma groups exhibited significantly lower scores compared with the normal control group. However, glaucoma subjects with moderate and severe visual field deterioration had similar responses to the instrument.⁴⁶ GQL-15 showed excellent validation features (Internal consistency: Cronbach $\alpha = 0.95$, test-retest reliability: $r = 0.87$), while significant correlations were found between GQL-15 responses and a number of psychophysical measurements: Esterman (binocular) visual field ($r = -0.39$), dark adaptation ($r = 0.34$), perimetric mean deviation (MD) values ($r = -0.6$), Pelli-Robson contrast sensitivity ($r = -0.45$, $P < 0.001$), glare disability ($r = -0.41$, $P < 0.001$) and stereopsis ($r = 0.26$, $P = 0.04$).⁴⁶

Increasing disease severity led to a poorer QoL status, as demonstrated by means of the instrument.⁵⁶ Central and near vision, peripheral vision, and outdoor mobility were the most affected domains among individuals with glaucoma.⁵⁶

5.3 The symptom impact glaucoma score (SIG) and glaucoma health perceptions index (GHPI)

Both instruments were designed and developed for the Collaborative Initial Glaucoma Treatment Study (CIGTS). The SIG consists of 43 queries that are categorized into four subscales: visual ability, local eye, systemic and psychological domains. The GHPI contains 6 queries that try to explore the impact of glaucoma on emotional, physical and social aspects of QoL. In addition, the items of GHPI address the stress and worry about blindness domains that are in association with living with glaucoma.²⁸

Both instruments exhibited good internal consistency and reproducibility (Cronbach α and ICC > 0.70).²⁸

After administration to glaucoma subjects, both the SIG visual function subscale and the GHPI associated significantly with visual field scores of the worse eye. However the coefficients of correlation were found poor ($r = 0.136$ and 0.165 , respectively).^{28,30} These instruments are efficient tools for research settings but seem to have a limited role in clinical practice, since a 10-hour training course was necessary before being administered to individuals.

6. Measures of visual function and activities of daily living in glaucoma

QoL studies suggest tasks requiring central/near vision (i.e. reading), outdoor mobility and driving as the most deteriorated activities of daily living among glaucoma subjects.^{9,49,56}

Furthermore, the presence of bilateral glaucoma and worse VF impairment seem to be the most significant predictors of functional ability regarding glaucoma individuals.⁴⁸

Regarding central/near vision activities such as reading, in the Salisbury Eye Evaluation (SEE) bilateral glaucoma was associated strongly with reporting the most difficulty on the near vision subscale of the ADVS tool (odds ratio 4.57), while the presence of unilateral glaucoma was not correlated with any ADVS subscales.³⁵ Furthermore, other relative studies regarding glaucoma patients have revealed an association between Esterman binocular VF deterioration and both difficulty of finding the next line or following a line in a text and reading speed.^{50,51}

With regard to outdoor mobility, glaucoma patients demonstrated slower walking speed when compared with age-matched non-glaucoma subjects, whereas walking speed was found to correlate significantly with MD in the worse eye.⁵² In addition visually impaired glaucoma patients were found more prone to accidents and falls compared to glaucoma subjects without severe VF loss (odds ratio: 1.6)⁶, whereas glaucoma subjects presented a 2-4 time greater probability of falling compared to normal control subjects.^{53,54}

Concerning driving limitations, glaucoma patients tend to self-report more difficulties in driving, while this self reported difficulty correlates with deteriorating VF scores.^{2,40} The SEE study demonstrated that patients with bilateral glaucoma had significantly poorer scores on the night driving subscale of ADVS compared to patients with unilateral glaucoma and normal control subjects.³⁵ Subjects with bilateral glaucoma were also more likely to report the most difficulty on the night driving subscale (odds ratio: 4.19).³⁵ In the same study the association between binocular VF and night driving subscale was found marginal, while VA and contrast sensitivity (which is a measure that surely deteriorates by glaucoma) were associated strongly with lower scores on the aforementioned subscale.³⁵

Most of the aforementioned results are in accordance with analogous literature reports using other QoL assessment instruments such as the NEI-VFQ and NEI-VFQ-25 questionnaires.^{40,55} Furthermore, there are a series of studies confirming the negative impact of visual field deterioration expressed by means of scores such as MD, pattern standard deviation (PSD), Advanced Glaucoma Intervention Study (AGIS) and CIGTS on the total QoL status of individuals with glaucoma.^{30,39,46,57-62} These findings are further supported by the presence of the correlation between QoL and VF scores even among individuals who were unaware of having glaucoma.⁶²

7. Conclusion

QoL is a multidimensional, subjective and dynamic sense. An effort to capture the patients' perceptions and feelings regarding their QoL is difficult to accomplish only by means of an artificial construct (i.e QoL questionnaires) and that is because no one can fully comprehend exactly how an individual perceives his own QoL state and eventually how he feels.

An ideal glaucoma QoL assessment tool should be multidimensional (comprise physical, social and mental components), enable self-administration, demonstrate good psychometric properties and include items that are directly correlated with glaucoma-related clinical measurements and are more glaucoma-specific (i.e. GQL-15). In addition, it should be in state to discriminate glaucoma patients from healthy individuals and provide responses that correlate sufficiently with clinical parameters related to the disease (visual acuity, VF scores, contrast sensitivity).

A great variety of instruments has been administered to glaucoma patients in order to evaluate their QoL. All of them have advantages and constraints. Generic health-related

tools are useful to make comparisons of QoL in a wide disease spectrum (ocular or not), but their generic character limits their specificity for glaucoma. Nevertheless, vision-specific tools enable comparisons between glaucoma and other ocular diseases, whereas they are more able to distinguish glaucoma patients from normal subjects and correlate better with clinical parameters than generic tools.³² Furthermore, they have been used more frequently in glaucoma than other QoL instruments. The NEI-VFQ and NEI-VFQ 25 remain the benchmark in the vision-related QoL evaluation, with the domains of 'general health', 'expectations', 'mental health', 'near activities' and 'driving' being the most affected by glaucoma.³³ Glaucoma-specific tools are usually composed of items regarding (glaucoma-related) symptoms and activities of daily living that are more likely to be affected by the disease. Furthermore, they try to evaluate the importance that the patients place to their QoL deterioration because of the disease.⁴⁷ Although having specificity for glaucoma and correlating strongly with clinical measurements, they do not enable comparisons between QoL in glaucoma and other ophthalmic diseases.

Research of QoL in glaucoma in recent years has demonstrated significant progress and has provided important insights regarding how and to what extent glaucoma impacts on patients' daily living. Studies suggest that glaucoma patients with bilateral VF deterioration demonstrate worse performances in activities of daily living, especially in the domains of mobility and driving.⁴⁸ In a literature review that tried to compare QoL in glaucoma and other ocular morbidities, glaucoma proved to exert a stronger impact on mental aspects of QoL rather than physical ones.³³ The authors suggested the asymptomatic (in early stages) nature of the disease as a possible explanation. Glaucoma unlike other ophthalmic diseases respects the central visual acuity and therefore the ability of individuals suffering from the disease to perform certain physical activities could be maintained to a greater extent. Finally they concluded that the insufficient education of glaucoma patients regarding their disease combined with their worry of possible blindness may lead to a further deterioration of mental QoL.³³

There is no ideal glaucoma QoL instrument, mainly due to the complexity and subjectivity of QoL. Further research efforts are needed that will address the weaknesses of QoL tools with regard to their construction and analysis of the data that are acquired.

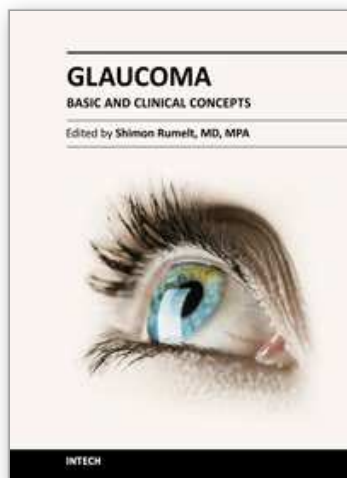
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This book addresses the basic and clinical science of glaucomas, a group of diseases that affect the optic nerve and visual fields and is usually accompanied by increased intraocular pressure. The book incorporates the latest development as well as future perspectives in glaucoma, since it has expedited publication. It is aimed for specialists in glaucoma, researchers, general ophthalmologists and trainees to increase knowledge and encourage further progress in understanding and managing these complicated diseases.

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